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A study of the hydration of ribonuclease A using isothermal calorimetry: Effect of the protein hydrophobicity and polarity

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Abstract

© 2014 Akadémiai Kiadó, Budapest, Hungary. This work is part of a systematic study undertaken to find the excess thermodynamic functions of binary protein-water systems. Isothermal calorimetry and water sorption measurements were applied to characterize the hydration dependencies of the excess thermodynamic functions. The advantages of our methodology are (i) we are able to simultaneously determine the excess partial quantities of water and proteins; (ii) these thermodynamic quantities can be determined in the entire range of water content. Here, in particular, the excess partial enthalpies of water and bovine pancreatic ribonuclease A (RNase A) have been determined. The excess partial enthalpies for RNase A are compared with the published data for several unrelated globular proteins (lysozyme, chymotrypsinogen A, serum albumin, lactoglobulin). These biomacromolecules represent a series of proteins in which the hydrophobicity of proteins is gradually changed in a wide range. It was found that the excess partial quantities for the studied proteins are determined by the hydration of the hydrophilic and hydrophobic protein groups. The more hydrophilic a protein, the more significant a hydrophilic hydration contribution is and vice versa. RNase A is the most hydrophilic protein under the study. This protein has the most significant hydrophilic hydration contribution. Lactoglobulin is the most hydrophobic protein under the study. This protein has the most significant hydrophobic hydration contribution.

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Keywords

Enthalpy, Excess functions, Isothermal calorimetry, Protein (biomacromolecule) hydration